

# PROBLEMS OF AUTOMATION AND MECHANIZATION

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## IMPROVING THE PRODUCTION TECHNOLOGY OF CERAMIC CASES FOR FUSES

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An improved design of ceramic cases for fuses and a device for automatic thread cutting on two sides of molded cases are described.

In a fuse that disconnects an electric circuit under excess current, the metal wiring is fastened to the ceramic case with screws. The manufacturing process used until recently provides for preliminary automated drilling of holes with diameter  $d$  over the whole length of the case after which thread  $M$  is cut in it (Fig. 1a). The thread holes should be separated by a certain distance  $l$  (current leakage path length) the minimum value of which should be enough for preventing discharge between the fastening screws in the assembled operating fuse.

The case preforms are manufactured in vacuum presses by extruding a plastic ceramic mixture through a nozzle. The outlet part of the nozzle has a cross section repeating the configuration of the cross section of the fuse, i.e., the cavity for placing the fuse insert is shaped simultaneously with the four through thread holes for the screws for fastening the metal wiring.

Due to the use of a plastic mixture with an elevated moisture content (18–20%), the quality of the cases diminishes because of deformation in the subsequent process stages; a certain shift of the axes of the holes relative to that of the thread-cutting tool worsens the threading quality. The presence of cavities of length  $l$  between threads  $M$  worsens the operational functions of the fuse because of the dirt and water condensate accumulated in these cavities, which decreases the leakage path length. This diminishes the discharge voltage (the voltage at which the medium filling the space between the fastening screws experiences an electrical breakdown) and determines the upper limit of the insulating capacity of the casing of the fuse.

In order to eliminate these drawbacks and improve the design and production process of insulating fuse cases, the

Slavyansk Institute of Ceramic Machine Building developed novel technology and an installation for molding fuse cases with closed thread holes  $M$  isolated by jumper  $K$  made of a moldable electroceramic material (Fig. 1b). The installation (Fig. 2) includes device 1 for extruding the preforms (vacuum press), receiving belt conveyer 2, air cylinder 3 for transporting the preforms to slide 4 and thread-cutting lathe 5.

### Basic characteristics

Sizes of preforms, mm:	
size of square . . . . .	45, 56, 73
length . . . . .	73.5
Number of simultaneously shaped case preforms, pieces:	
KF-40/65 . . . . .	48
KF-50/65 . . . . .	36
KF-66/65 . . . . .	30
Depth of thread, mm. . . . .	14–20
Thread parameters, mm:	
outer diameter . . . . .	4.6
thread pitch . . . . .	1.814
Feed circuit:	
voltage, V . . . . .	380
frequency, Hz. . . . .	50

The vacuum press is based on the continuous-action device for fabrication of ceramic preforms described in USSR Inventor's Certificate 1595648.

The device for extruding preforms (Fig. 3) includes a mechanism for forced feeding of the ceramic mixture in the form of screw conveyer 1 mounted in casing 2 and connected with rotation drive 3. The device also includes ring 4 and rod 5 current-conducting electrodes, where the rod is combined with spacers 6 and seal ring 7. Electrodes 4 and 5 are insulated from each other by insulating pad 8 and

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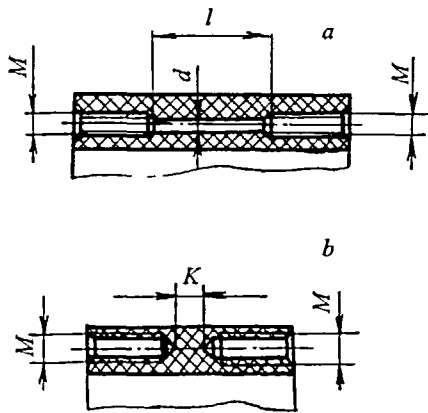


Fig. 1. Part of a ceramic case for a fuse with through (a) and blind (b) thread holes.

are fastened to the outlet flange of the casing. The ring electrode is positioned coaxially with the screw conveyor, and the rod electrode is coaxial with the cavity of electrode 4.

Ceramic preform 9 is positioned on receiving conveyor 10 to one of whose drum shafts is connected a velocity-type transducer (tachogenerator) 11.

In addition, the device contains a three-phase supply source 12 connected to the inputs of rectifier 13, direct current-to-alternating current converter 14, and timer 15.

The device operates as follows.

As the screw conveyor rotates, the ceramic mixture is forced through the cylindrical part of the casing passing between the spacers and then between electrodes 4 and 5. The alternating current from the converter supplied to these electrodes (to electrode 5 through the seal ring and spacers) is closed through the ceramic mixture between the electrodes and causes its heating. The heated preform passes to conveyor 10, is pressed to its belt by its own gravity, sticks to the belt and rotates the drums of the conveyor, and the rotation rate of the drums varies synchronously with the change

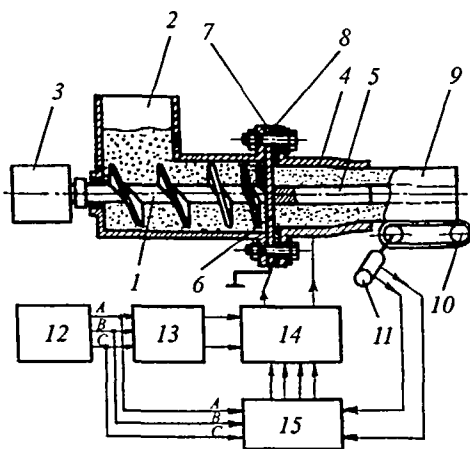


Fig. 3. Block diagram of the device for extrusion of preforms.

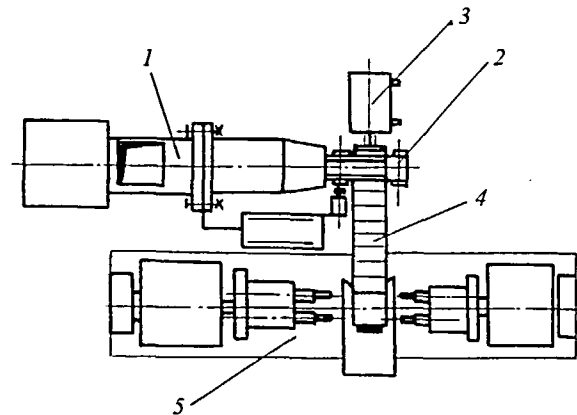


Fig. 2. Packaging of the equipment for shaping fuse cases with blind thread holes.

in the extrusion rate of the preform. The velocity transducer connected to one of the drums of conveyor 10 creates voltage whose value is directly proportional to the rate of extrusion of the preform.

The three-phase alternating voltage arriving from supply source 12 is rectified by the rectifier and applied to the force input of the direct-to-alternating current converter.

As a result, different parts of the preform are heated to the same temperature independently of the extrusion rate. This eliminates overheating of local regions and makes it possible to stabilize the time of subsequent drying and hence improve the quality of the preforms.

The block-diagram of the thread-cutting lathe is presented in Fig. 4. Two spindles (left 2 and right) are mounted on rigid table 1. In Fig. 4 the right spindle is closed by enclosure 3. Each spindle contains lead screw 4 with nut 5. The lead screw is driven by electric motor 6 by means of V-belt transmission 7.

The lead screw serves for moving board 8 with four-position head 9 and thread taps 10 mounted on it and for cutting a thread in preform 11. Gauge 12 serves for choosing the requisite height when the standard size of the case is to be changed and guide 13 is used for controlling the motion of the board.

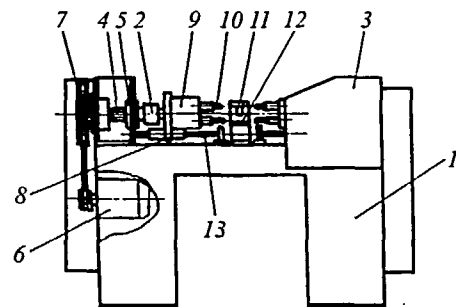


Fig. 4. Thread-cutting lathe.

The operation of the described installation virtually does not differ from the techniques used in conventional lines for manufacturing ceramic fuse cases. However, since the preform is heated over the whole of the cross section, it is possible to use the method of hard extrusion, i.e., to use ceramic mixtures with a reduced moisture content and molding powders or fibers. Extrusion of the preforms in the vacuum press (see Fig. 2) can be stepwise or continuous with cutting of the preforms by flying cutting tools. It is also possible to extrude several lengthy bars of two, three and more standard case sizes simultaneously with subsequent cutting of each bar into preforms of the requisite length and transporting them to the thread-cutting zone.

The installation operates as follows.

The ceramic mixture loaded in the vacuum press by the screw conveyer is transported, compacted and extruded onto the belt conveyer. In the nozzle, the mixture is heated over the whole of its cross section, becomes easily movable, and acquires the shape of the outlet cross section of the nozzle. Then the requisite length of the preform is cut-off by the flying cutting tool, pushed to the slide by the air cylinder, and arrives in the lathe thread-cutting zone (see Fig. 2) on the special support in the center of the table (see Fig. 4). Then the electric motors are started and begin to rotate the screw

through the V-belt transmission. The screw screws into the nut and moves the board with the head over the guides (see Fig. 4). Rotation is transferred through a special coupling to the four-spindle head that, in addition to rotating the screw, initiates rotation of the taps and simultaneously moves them in the longitudinal direction. One turn of a tap corresponds to its displacement by one thread pitch (1.814 mm).

Each board is connected to four path switches. Two of them (contactless) are used for controlling the operation of the lathe in the functional regime, one works out the command for reversal of the drive and unscrewing of the taps, the other sends a stop command at the end of thread cutting. The other two switches (contact) work in emergency situations at the extreme positions of the board.

Thus, after the electric motors start up, the rotating taps are moved to the preform on two sides. Having reached the extreme position, the boards close the path switches. This causes reversal of the electric motors; the taps begin to unscrew. Eight thread openings are formed in the preform. In the other extreme position of the boards, the electric motors are switched off, and the threaded preform is removed from the lathe and transported to the subsequent process stages; the described stage is repeated.

The equipment can be used in production of electro-technical, structural, household and other ceramic articles.